09/830929
JC18 Rec'd PCT/PTO 01 MAY 2001
PJE-001

Clock

The present invention concerns a clock, driven by a mechanical, electrical or electronic motor, with analog and unambiguous 24 hour display in accordance with the preamble to Claim 1. Several clocks with analog and unambiguous 24 hour display are known, for instance from DE 267 810 (D1), US 5,696,740 (D2), WO 91/03774 (D3).

Both in D1 and in D2 the 24 hour unambiguity is obtained by means of two concentric number scales each of 12 hours, where the first 12 hour group comprises the times from 0-12 o'clock, the second the time from 12-24 o'clock. On the transfer from one scale to the other the hour hand always changes its position in an abrupt manner; it either travels outwards or is shortened.

In D3 the unambiguity of the display of the hours is addressed similarly in that two concentric 12-hour scales are arranged on the dial, at the same time however a transparent disc is present which has a period of revolution of 24 hours and - in one embodiment - has two semi-circular shaped covers, which cover the non-applicable hour values.

Further documents - though not under consideration here - (i.e. DE 33 05 414 and DE 40 376 57) show clocks with so-called pseudo-analog presentation, where using electronic auxiliary means, such as LEDs and liquid crystal displays, an unambiguous 24-hour display is created.

The arrangements published in D1 and D2 for the changing of the length of the hour hand require either additional energy from the clock motor for tensioning a spring (D1) or an additional source of energy (D2). The solution proposed in D3 shows the hours at all times of the day and night on two semi circles of different radius. Neither in terms of technical producibility nor in market acceptance were these solutions able to succeed.

Although it would be possible with the means described, the transfer from one scale to the to the other was never chosen to be other than at midday and midnight.

Further, clocks have become known, which have non-circular scales, such as for instance in DE 196 41 885 (D4), DE 299 03 950 (D5) and DE 299 04 451 (D6). Whilst in D4 an hour indicating element is moved on any desired

curve as a guiding element, in D5 the indicating element is guided on cycloids, which are generated by a four joint drive, by means of an additional gear wheel, means are described here to move the aforesaid indicating element on non-circular tracks, but a 24-hour indicator of an unambiguous nature is not published therein.

It is therefore the aim of the present invention to move the hour marking indicating element - whether this is the hour hand or a clear and unmistakeable element - on a track of this construction, which permits an unambiguous arrangement of the positions of the indicating element during the 24-hour passage of the day and so by its position effects a conspicuous difference between the daytime and night-time hours without the need to alter the customary angular positions of the indicator.

The addressing of this aim is given in the characterising part of Claim 1 with regard to its essential features, in the following Claims with regard to further developments of the invention.

The inventive idea is more closely explained using the attached drawing in several embodiments.

Shown are:

Fig. 1 the plan view of a first embodiment,

Fig. 2 a part of Fig. 1, with a first embodiment of a guide element,

Fig. 3 a longitudinal section through the embodiment in Fig. 1,

Fig. 4 a detail from Fig. 3 with a second embodiment of a guide element,

Fig. 5 a second embodiment in a schematic longitudinal section,

Fig. 6 the embodiment in Fig. 5 in a schematic plan view.

Fig. 1 is a plan view of a first embodiment of a clock according to the invention. Along with conventional and here adopted elements, such as a minute hand 1, second hand 2, date display 3 and a conventional circular minute scale 4, an hour hand 5 with variable length is shown. The point of the hour hand 5 runs

around a two loop enclosed curve 7 with an outer loop 8 and an inner loop 9, which have a crossing point 6. The daytime hours from 6 to 18 hours are allocated to the outer loop 8 and the night-time hours from 18 to 6 hours to the inner loop 9. Since these allocations are only of a graphical nature, they can obviously be reversed. One such two loop curve is for instance the conchoid, also called the Pascal snail curve, (described, for instance, in Karel Rektorys, Applicable Mathematics, Cambridge, Mass., USA 1969). Fig. 1 includes the representation of a second conchoid 10, shown dashed, which is derived by a constant radial offset from the curve 7 with an outer loop 8 and an inner loop 9. This second conchoid 10 is shown dashed because it can be covered by a disc 11; it is formed as a guide curve and together with the guiding elements is more clearly explained in Fig. 2.

Fig. 2 is the representation of only the inventive part of the clock. The disc 11 is shown here only dashed and transparent and allows a clear view of the conchoid 10 lying below and covered by the disc 11. The hour hand 5 is, as was already seen in Fig. 1 constructed from two parts. Its outer part, referenced with the reference 13, is joined in a pivoting manner to a sliding element 12; this sliding element 12 lies in the for instance groove shaped conchoid 10 and follows the track of this conchoid during the circulation of the inner part of the hour hand 5. This inner part of the hour hand 5 carries the reference 14, and is joined firmly to the disc 11. The disc 11 thus completes a revolution in 12 hours, together with the inner part 14 of the hour hand 5. The sliding element 12 is formed in this embodiment in a sickle shape such that the radius of curvature of the outer-lying surface is smaller than the smallest radius of curvature of the outer surface of the conchoid 10, and that of the inner lying surface is greater than the greatest radius of curvature of the inner surface of the conchoid 10. The longitudinal extension of the sliding element 12 measured in the tangential direction is made large enough so that at the crossing point of the two loops of the conchoid 10 (which carry the references 15, 16) the sliding element 12 is guided securely from the outer loop 15 to the inner loop 16, or from the inner loop 16 securely onto the outer loop 15.

Fig. 3 is a longitudinal section through the embodiment of Fig. 1 for instance at 24 hours. A dial 24 serves here in the sense of a non-limited example of a mounting platform for all further named and yet to be named elements. This element named below as dial 24 can be attached either to the works or the case. It is only

essential that in the operation of the clock the relationship to the actual dial is fixed. The conchoid 10 with its outer loop 15 and its inner loop 16 is worked into the dial 24 for instance by milling. A hollow shaft, called the hour tube 18, is mounted within the dial 24, with which the disc 11 and the inner part 14 of the hour hand 5 are joined firmly. For stability reasons the inner part 14 of the hour hand 5 is joined to the disc 11 for instance with a support 19. The disc 11 has a radial slit 20 running parallel to the inner part 14 of the hour hand 5. A guide pin 12, with which the outer part 13 of the hour hand 5 is joined to the sliding element 12, can move in this slit 20. The sliding element 21 is thus moved in an azimuthal direction by the disc 11. The guide pin 21 is for instance firmly fixed to the sliding element 12 and mounted in the outer part 13 of the hour hand 5 so as to pivot about its long axis. In accordance with the invention this can however also be arranged so that the guide pin 21 is firmly fixed to the outer part 13 of the hour hand 5 and mounted on the sliding element 5 so as to pivot about its long axis.

The outer part 13 of the hour hand 5 is arranged so as to be able to slide in the longitudinal direction with respect to its inner part 14, for which arrangement several solutions are known and not to be described here.

The remaining elements, such as the minute tube 22 with the minute hand 1 and the second axle 23 with the second hand 2 are known and only mentioned for completeness. The concept of the dial can be widely interpreted here; the decision as to which and whether figures appear on it is purely of an aesthetic nature. The technical significance of the dial 24 lies in its characteristic as a baseplate for all the previously mentioned elements in the sense of the previous description.

A section of the conchoid 10 is shown in Fig. 4, together with a further embodiment of sliding element 12 from Fig. 2, 3 named a guide element 17. This comprises a carrying member 25 and here for instance three wheels 26, 27, 28 rotatably mounted within it. Their arrangement is selected such that the middle wheel 26 lies outside, so that it can touch the outer surface of the conchoid 10; the other two wheels 27, 28 can touch the inner surface of the conchoid 10. The arrangement of the three wheels 26, 27, 28 is further so designed that the guiding element 17 both in that part of the conchoid 10 with the greatest radius and also that with the smallest it can be moved with radial play in the

tangential direction. In the region of the middle wheel 26 the carrying member 25 carries the guide pin 21, for which the same applies as previously stated under Fig. 3.

Also included in Fig. 4, however dotted, is a modification of the carrying member 25. One arm 29 of the carrying member 25 is constructed as a flexing spring 30, so that all three wheels 26, 27, 28 can always touch the side surfaces of the conchoid 10 assigned to them. Alternatively both arms of the carrying member 25 can be constructed as flexing springs 30, whereby the applied pressure of the wheels 26, 27, 28 onto the side surfaces can be better apportioned.

The length of the guiding element 17, that is the separation of the wheels 27, 28 is chosen such that the crossing point of the two loops 15, 16 of the conchoid 10 can be passed in the correct sense. The number of wheels 26, 27, 28 can obviously be chosen to be different, for instance larger, with a corresponding adaptation of the form and construction of the carrying member 25.

Figures 5 and 6 are representations of a second embodiment for the guidance of the point of the hour hand 5 onto the two loop curve 7 provided. Fig. 5 is a section perpendicular to the plane of the dial 24, Fig. 6 a plan view. For a better understanding, Fig. 5 is produced so that all the sequential axes lie in the same plane, which actually is never the case.

In Fig. 6 a two-loop curve (also called a Pascal snail) 31 is shown dashed, with an outer loop 40 and an inner loop 41 and a crossing point 42. This corresponds functionally to the conchoid 10 from Fig. 2 and also in so far as it at least indicates the track of the guide pin 21 in so far as that obviously a radial offset by a constant, or also by a variable amount - for instance proportional - is included within the inventive idea. This curve 31 is generated in this embodiment by the interworking of several gear wheels and guide arms, as set out below:
Firmly fixed to the dial 24 - or the assembly platform corresponding to it - is a gear wheel <u>A</u> with radius r(A), coaxial with the hour tube 18. The hour tube 18 carries an arm 32, circulating with it, in which an axle 36 of a second gear wheel <u>B</u> with radius r(B) is mounted, whereby:

$$r(B) = 2r(A) \qquad \text{equation (1)}$$

Further these radii and the crossing point 42 of the two loops 40, 41 of the curve 31 - whose distance from the

centre of the hour tube is designated d(31) - are connected such that

$$r(A) + r(B) = d(31) \qquad \text{equation (2)}$$

The arm 32 can be a flat-formed component in a plane parallel to that of the gear wheels. It carries here, firmly fixed to it, a third gear wheel C with radius r(C), which meshes with a fourth gear wheel D1 with radius r(D1), which is mounted on an axle 33. This is mounted in a second arm 34. The second arm 34 sits firmly on the axle 36 of the second gear wheel B and therefore runs around with this. The axle 33 of the fourth gear wheel D1 carries - similarly joined firmly to it - a fifth gear wheel D2 with radius r(D2) which meshes with a sixth gear wheel E with radius r(E). This sixth gear wheel E is mounted on an axle 35, which is fastened on the second arm 34 at a distance d(E) from the axle 36 and runs parallel to all the previously mentioned axles. The sixth gear wheel E carries at a distance d(F) from the axle 35 the guide pin 21 running parallel to the axles 33, 36.

The following equations apply for the further named radii and distances:

$$r(D1) = \tfrac{1}{2}r(C) \qquad \text{equation (3)}$$
$$r(E) = r(D2) \qquad \text{equation (4)}$$
$$d(E) = d(F) \qquad \text{equation (5)}$$

Whilst the crossing point 42 of the two loops 40, 41 is fixed by equation (2), the two loops 40, 41 themselves are only defined by the equations (3), (4), (5) and (6):

$$d(40) - d(41) = 4d(E) \qquad \text{equation (6)}$$

The choice of r(C) is not dependent on r(A), but purely opportunistically based on the available space, with the limitation that - if the hour tube 18 is given the radius r(18) -

$$R(C) < r(A) + r(B) - r(18) \qquad \text{equation (7)}$$

The disc 11 and the outer and inner parts 13, 14 of the hour hand 5 are not shown in Fig. 5, 6. All these elements can be arranged as shown in the first embodiment.

As a modification to this the actual dial 24 can be made at least partly transparent and arranged such that

the minute and second hands 1, 2 run above it, the hour display, however, below it. Instead of the guide pin 21 the gear wheel E then bears an especially prominent marking, owing to its brightness or colour - for instance a round small disc - which runs around the two-loop curve 31. This small disc then replaces the point of the hour hand 5. The latter and also the aforesaid small disc are then indicating elements.

For the gearing specialist other arrangements of gear wheels and possibly the arms carrying them, can be realised and are included in the inventive idea, which fulfil the aim of generating the desired conchoid as a track for the indicating element, using a guide pin 21 or a corresponding component.